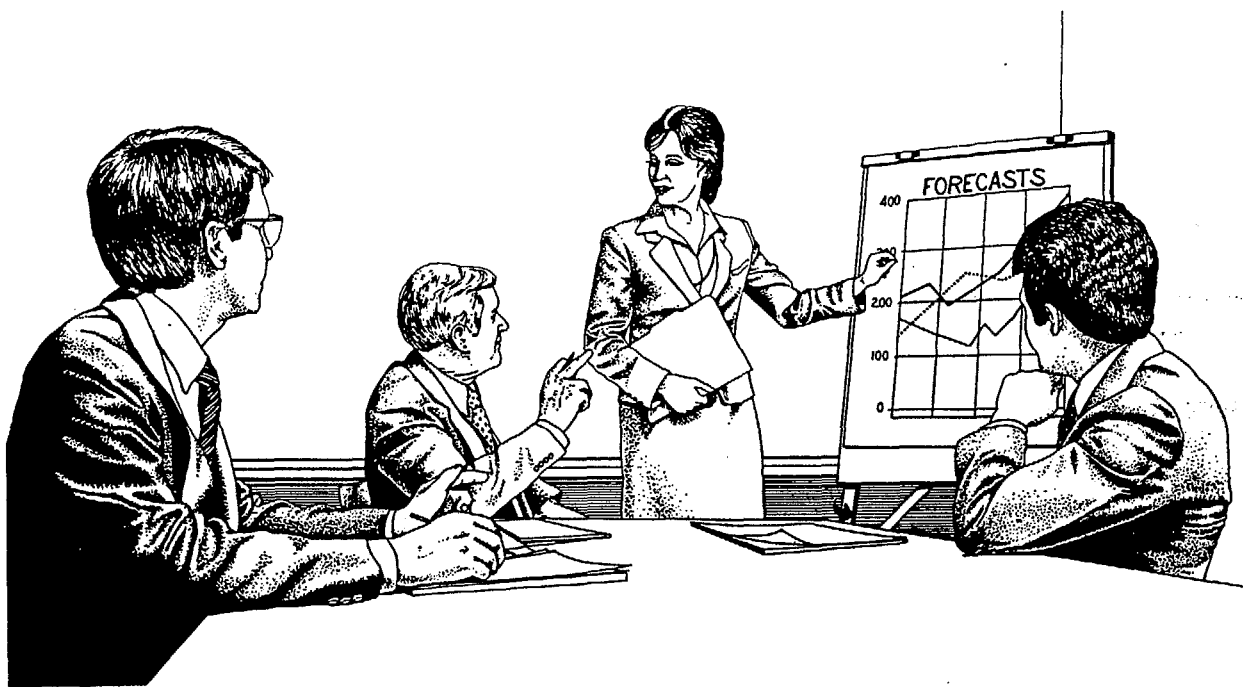


CHAPTER TWO

FORECASTS



Chapter Two

AVIATION DEMAND FORECASTS

The proper planning of a facility of any type must begin with a definition of the needs that the facility can reasonably be expected to serve over the specified planning period. At Kingman Airport, this involves the development of a set of forecasts that best defines future aviation demand. Forecasts of general aviation and commercial service activity at the airport can be used as a basis for determining the types and sizes of aviation facilities required to meet aviation needs.

Forecasts are applied to several phases of the study. Initially, they are used to analyze the capacity of the airfield, the terminal area, and the access system. They are also used to evaluate the airport's role in the regional airport system, which can affect the need for improved navigational systems. Later in the study, they will be used in the financial analysis and alternative development actions. Finally, the aviation forecasts are used to develop measures of aircraft noise and determine air quality impacts.

The primary objective of a forecasting effort is to define the magnitude of change that can be expected over time. Because of the cyclical nature of the economy, it is virtually impossible to predict with certainty aviation activity on a year-to-year basis over an extended period of time. However, a growth curve can be established to predict the long-term growth potential.

While a single line is often used to express the anticipated growth, it is important to remember that actual growth may fluctuate above and below this line, actual growth in activity seldom follows a simple straight line or mathematical curve. Forecasts serve only as guidelines, and planning must remain flexible to respond to unforeseen events.

Aviation activity at an airport is affected by many external influences, as well as by the facilities and services available. Few industries have seen as dynamic a change as the aviation industry since the first powered

flight. Major technological advancements as well as regulatory and economic actions have resulted in erratic growth patterns which have had significant impacts upon aviation activity. More recently, regulatory and economic actions have created very significant impacts on activity patterns at most airports. The following sections attempt to define the historical trends and discuss how other influences may affect future trends in establishing forecasts of aviation activity.

FORECAST PROCEDURES

The systematic development of aviation forecasts involves both analytical and judgmental processes. A series of mathematical relationships are tested to establish statistical logic and rationale for projected growth. Judgment of the forecast analyst, based upon professional experience and knowledge of the situation, is important in the final subjective determination of the preferred forecast.

The analysis begins with the assessment of historical trends on a variety of aviation indicators at the local, regional, and national level. Aviation indicators, such as aircraft operations and based and registered aircraft were obtained for the analyses. Similarly, socioeconomic factors such as population, income, and employment are also analyzed for the effect they have historically had on aviation activity. The identification and comparison of the relationships between these various indicators provides the initial step in the development of realistic forecasts of aviation demand.

As part of the analytical process, trend lines based upon historical relationships are extended into the future based upon these techniques and assumptions. Trend lines developed through the use of a variety of techniques are called projections. After preparing several such projections, the analyst is able to identify a range of growth within which the true trend will probably lie.

FORECAST METHODOLOGY

The most reliable approach to estimating future aviation demand is to use several analytical models, and then compare the results. The most common techniques used include correlation analysis, regression analysis, time-series extrapolation, and market-share analysis.

Correlation analysis examines the direct relationship between two or more sets of historical data. Used primarily as a statistical test on a multiplicity of variables, this analysis will detect significant correlations between sets of data. These sets can then be evaluated further using regression analysis.

In *regression analysis*, projections of an aviation demand element (the dependent variable) are prepared based upon its relationship to one or more aviation indicators, known as the independent variables. Enplaned passengers and based aircraft are examples of dependent variables, while population, per capita income, gross national product, and other socioeconomic factors are examples of independent variables. Linear, curvilinear, and multiple regression analyses all can be tested in an attempt to define a relationship from which future activity can be projected.

Time-series, least squares extrapolation is probably the simplest, most widely used method of forecasting. This technique involves the fit of classical growth curves to future years. In utilizing this technique, an assumption is made that the same factors will continue to affect future demand. While this can be a rather broad assumption, it provides a reliable benchmark for comparing the results of other analyses.

The *market-share* technique involves a review of the airport's activity in terms of a larger aviation market. The local share-of-the-market factor is multiplied by forecasts of the

larger market for a projection. This top-down approach proves useful as a check on the validity of other techniques.

Using a broad spectrum of local, regional, and national socioeconomic information, surveys and aviation trends, forecasts were developed for several key aviation activity categories, including the following.

- ♦ Commercial Service passenger enplanements and aircraft operations.
- ♦ General Aviation Based Aircraft and Operations, and Military Activity.
- ♦ Peaking Characteristics and Aircraft Mix.
- ♦ Annual Instrument Approaches.

At this point, the second phase comes into play. The analyst must study the various growth elements and by utilizing experienced professional judgment, weigh several other intangible factors before finalizing a forecast. These factors include the following.

- ♦ Uses for which the forecast is being developed.
- ♦ Character of the community.
- ♦ Potential changes in the general business environment.
- ♦ State-of-the-art advances in technology.
- ♦ Impact of new facilities or improved services.
- ♦ Policies of the airport owner and operator.

Two important considerations bear upon the finalization of forecasts for planning purposes. First, one cannot assume a high level of confidence in forecasts that extend beyond five years. However, more than five years is often needed to complete a facilities development program and at least twenty years is necessary to assure the proper return on the investment. The second consideration is the level of optimism reflected in the forecasts. The planning effort must include a flexibility that is relatively insensitive to fluctuations in aviation activity.

TRENDS AT THE NATIONAL LEVEL

Each year, the FAA publishes its national aviation forecast. Included are categories for air carriers, air taxi/commuters, general aviation, and the military. The forecasts are prepared to meet budget and planning needs of the constituent units of the FAA and to provide information that can be used by state and local authorities, the aviation industry and the general public.

The current edition of this annual forecast is **FAA Aviation Forecasts, Fiscal Years 1989-2000**. Summarizing the assumptions under which the forecasts were developed, strong economic growth is anticipated through the forecast period, real fuel prices are expected to rise, and moderate inflation is anticipated. The net result is a forecast that projects aviation activity growth at about the same rate as the general economy.

FAA aviation forecasts for the period 1988-1999 were developed utilizing projections of key economic variables provided by the Executive Office of the President, Office of Management and Budget. For the period 1994-1999, FAA aviation forecasts were based on consensus growth rates of key economic variables provided by Data Resources, Inc., Evans Economics, Inc., and Wharton Econometric Forecasting Associates. These projections are combined with projections of aviation variables and professional judgment on the probabilities and consequences of events that affect aviation. The combination is used as input to the econometric models from which the forecasts are generated.

Several conclusions have been drawn based on the background data and forecasts. The forecasts developed by these models indicate a continuation of strong growth for commercial operations. Due to a nine year slump in the general aviation manufacturing

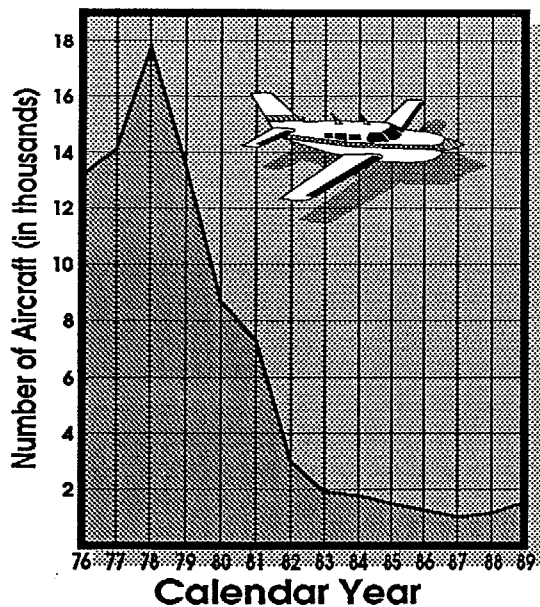


Exhibit 2A
Single Engine Piston
Aircraft Shipments 1976-1989

industry and expected low levels of production for the next few years, the forecasts for this segment of the industry have been significantly lowered. However, multi-engine piston and turbine-powered aircraft shipments showed improvements over totals for fiscal year 1986. Increased community resistance to airports is identified as having an uncertain impact upon the construction of new runways and major new airports. In order for the national forecasts to be realized, restrictions on capacity and system growth must be dealt with at an early date. The national forecasts assume that these threats to orderly growth are manageable and that there would be only minor fluctuations in the long-term growth expected for the industry.

The general aviation industry is undergoing deep and broad structural changes. These changes indicate that the long-term growth of the active fleet and activity will be slowing. From 1979 to 1987, general aviation shipments declined from a peak of 17,811 units in 1978 to 1,085 units in 1987, as reflected in **Exhibit 2A**. Since 1987, total shipments increased to 1,535 by 1989.

The major independent manufacturers have been replaced by conglomerates, and Cessna and Piper have suspended production of many of their piston-engine aircraft. For the foreseeable future, the large general aviation manufacturers will focus on the production of turbine powered aircraft. Ultimately, a declining number of pilots, combined with the slowdown in the expansion of the fleet will reduce the rate of growth of activity at FAA facilities.

Many experts felt that general aviation would eventually respond to the current economic recovery, but it has not. Historically, the economic cycle of general aviation closely paralleled that of the national economy. Theories abound as to why the continuing decline in aircraft sales and active pilots has not responded to recent economic growth. Some cite high aircraft costs, which have continued to increase, as reflected in **Exhibit 2B**. Others cite high operating costs and interest rates, changes in the tax code, and high product liability costs. There are those who believe the overvalued dollar severely depressed the export market. Some combination of these factors is surely responsible, and their negative impact has outweighed the positive effects of a growing economy.

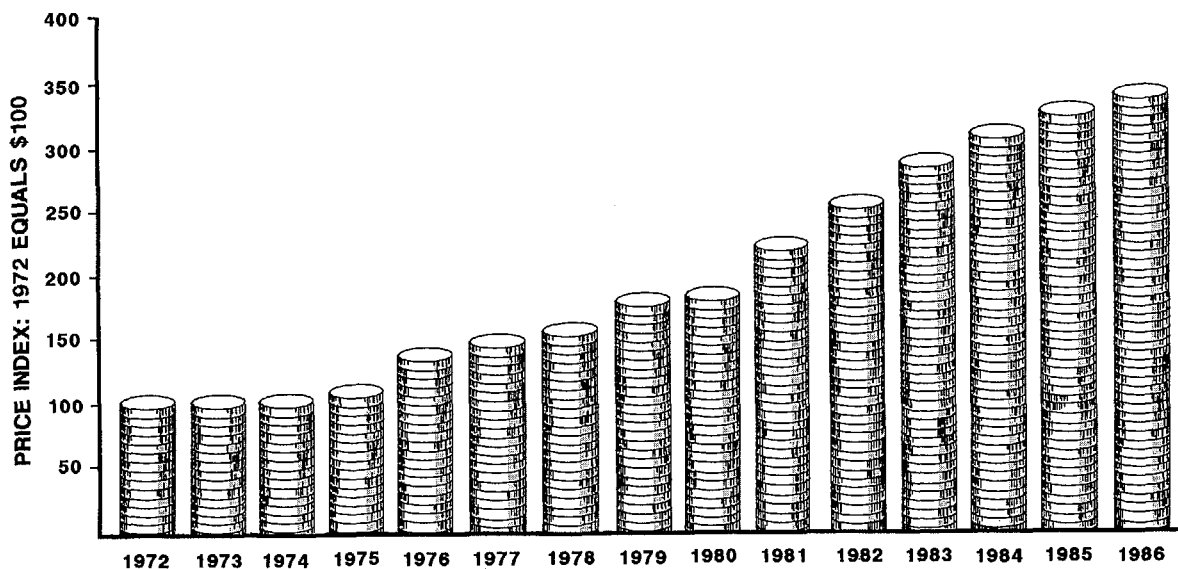


Exhibit 2B
Single Engine Piston Aircraft Prices
1972-1986

On the positive side, use of general aviation aircraft by business has increased. As a result, the characteristics of the general aviation fleet continues to change. The more expensive and sophisticated turbine powered component of the fixed-wing fleet is expected to grow much faster than piston aircraft between 1988 and 1999. A total of 9,700 turbine powered aircraft were in the fixed-wing general aviation fleet in 1988, representing approximately 4.8 percent of the total fixed-wing fleet. By 2001, it is estimated that roughly 7.2 percent of the total fixed-wing fleet will be comprised of turbine powered aircraft.

Using a forecast model which accounts for many of the preceding factors, the FAA has developed national projections for general aviation. The active general aviation fleet is projected to grow at an annual rate of 0.4 percent, from 212,900 aircraft in 1990 to 222,400 aircraft by the year 2001. Active single engine piston aircraft are projected to decline at an annual rate of 0.1 percent, falling from 166,200 in 1990 to 164,400 in the

year 2001. The number of multi-engine piston aircraft is expected to decline through 1994, and then to increase to about 100 aircraft per year until the total reaches the present level of 23,100 in the year 2001. Turbine powered aircraft are projected to increase from 9,800 in 1990 to 14,600 in 2001, growing at the rate of approximately 4.5 percent a year. The forecast of the turbine rotorcraft fleet shows a yearly increase of 8.1 percent.

AIRLINE ACTIVITY FORECASTS

Over the years, airline activity at Kingman Airport has been provided by commuter air carriers. At the present time, the airport is being served by Mesa Airlines. To determine the type and size of facilities necessary to accommodate airline activity at any airport, several elements of this activity must be forecast. The two elements considered most important include *Annual Enplaned Passengers* and *Annual Commercial Aircraft Operations*.

ANNUAL ENPLANED PASSENGERS

Historical Data

Since the late 1930's, airline service has been available at Kingman when Trans World Airlines was certificated to operate at the airport. Over the past fifty years, however, both the quality and quantity of air carrier activity has undergone tremendous change. During the 1960's and 1970's, the influx of jet aircraft into the air carrier market increased the average stage length of flights from 160 miles to 250 miles. Intermediate stops into the smaller communities, such as Kingman, became economically unfeasible as evidenced by Trans World Airlines terminating air service into Kingman in the mid 1970's. The Airline Deregulation Act of 1978 also influenced the type of air service into Kingman. Not only did the deregulation process result in extreme fluctuations in the number of passengers enplaned at Kingman, but major transitions into the short haul commuter market also occurred. The post deregulation period also coincided with a period of economic recession and rising fuel costs which, to some extent, affected every airport in the country. With the economic recovery of the early 1980's, and the establishment of Golden Pacific Airlines at the airport, annual enplanements increased almost 100 percent in three years. After that period, enplanement totals dropped in both 1985 and 1986, and then increased slightly in 1987. In 1988, Golden Pacific filed for bankruptcy and terminated air service to Kingman. In January of 1990, Mesa Airlines began providing air service to the airport. Although only a short period has elapsed, monthly enplanements since January show a steady climb from 88 the first month to 250 in the month of July.

The extreme fluctuations in historical enplanements at Kingman Airport can be explained partially by the fact that Kingman Airport has been served by only one commercial airline at any one time. In such

a case, if the airline experiences financial difficulty, withdraws from the airport or goes out of business, the level of commercial service can drop substantially or be eliminated entirely until another carrier begins operations at the airport. The rapid growth exhibited, however, during the years that Golden Pacific was financially strong, as well as Mesa Airline's growth during the first six months of 1990, reflects a potentially strong demand for commercial air service in Kingman and the surrounding area.

Enplanement Forecasts

Enplaning passengers are those who board a commercial service aircraft for departure from the airport. To develop new enplanement forecasts, several of the analytical techniques outlined previously are examined for their applicability. These include historical trend analysis, regression analyses, and market share analyses.

A number of *trend line* analyses were prepared for Kingman Airport, each based on several different historical periods. Unfortunately, due to the history of relatively severe fluctuations in enplanements, this forecasting method did not result in a strong correlation between historical enplanements and time.

Another projection method utilized was a type of trend line analysis, based on the historical ratio of enplanements per population for the period 1979 through 1989. In this method, ratios of the number of enplanements for the Kingman Airport to the population of the City of Kingman, Mohave County and the State of Arizona, for each corresponding year were calculated, and then an average ratio was calculated for the period analyzed. The resulting ratio expresses an average number of enplanements per 1,000 population. To determine forecasted enplanements levels, this ratio is applied to published forecasts of population for the City of Kingman, Mohave County and the State of

Arizona, during the planning period. The resultant forecast figures are listed in **Table 2A**.

Linear regression analysis utilizing several independent variables such as population, personal income, operations, etc., were also tested for projections of enplanements at Kingman Airport. In these analyses, a correlation factor, or "R" value, is used to measure the confidence level of projections. The closer the R-value is to 1, the higher the confidence level that the independent variable bears a direct relationship with the dependent variable (enplanements). As with the trend line analyses, the linear regressions resulted in very poor correlations between historical enplanements and the various independent variables tested.

Market-share analyses were also utilized to forecast enplanements at the Kingman Airport. In this calculation, an average market share of the U.S. Commuter and Regional Airline enplanements (from **FAA Aviation Forecasts Fiscal Years 1989-2000**) was determined for the period 1980 to 1989. A similar methodology was used with total enplanements within the State of Arizona (from the **ADOT Aviation Needs Technical Report** for the years 1995 and 2000), and the two enplanement forecasts were then compared. The forecasts which resulted from market shares of State and U.S. Commuter enplanements were selected for further analysis. The forecasts derived through this method were in general a little more optimistic than those derived through

the enplanement/population ratio method (**Table 2A**).

Also included in the table are forecasts of enplanement levels provided in the **National Plan of Integrated Airport Systems, 1986-1995 (NPIAS)**, the **Terminal Area Forecasts, 1989-2000 (TAF)**, and the previous **Terminal Area Master Plan for the Kingman Airport (1985)**.

Preferred Enplanement Forecast

Since Kingman Airport has been served by only one commercial airline at any time, dynamic fluctuations in enplanement levels have occurred historically. For this reason, it is safe to assume that while a fairly rapid growth in enplanements at the airport might be likely in the coming years, a drop in enplanements could occur again at some point in the future, and, therefore, a forecast should be selected that takes into consideration both the high and the low historic enplanement levels. The market share of State enplanements forecast (1979-1989), since it was based on an average market share of enplanements for the previous ten years, was considered the most realistic forecast. While this selected forecast is not the highest nor the lowest of those prepared, it does appear to be the most realistic in consideration of the historic growth and decline of enplanements experienced at the airport. The preferred enplanement forecast is included in **Table 2A** and illustrated on **Exhibit 2C**.

TABLE 2A
Forecast Enplanement Levels 1995-2010
Kingman Airport

<u>Year</u>	<u>Enplanement Per 1,000 Population Kingman</u>	<u>Enplanement Per 1,000 Population Mohave County</u>	<u>Enplanement Per 1,000 Population State of AZ</u>	<u>Market Share, U.S. Commuter Enplanements</u>	<u>Market Share, State Enplanements</u>
1995	3,000	3,100	2,700	5,000	5,500
2000	3,500	3,700	3,100	6,700	7,300
2005	4,100	4,300	3,500	8,200	8,900
2010	4,600	4,900	3,900	9,800	10,500

<u>Year</u>	<u>NPIAS 1986-1995</u>	<u>FAA TAF 1989-2000</u>	<u>Terminal Area Master Plan 1984</u>	<u>SANS 1990</u>	<u>Preferred Forecast</u>
1995	10,000	5,000	6,600	4,000	5,500
2000	NA	6,000	10,000	5,000	7,300
2005	NA	NA	12,400	-	8,900
2010	NA	NA	NA	8,000	10,500

NA = Not Available

AIRLINE OPERATIONS AND FLEET MIX

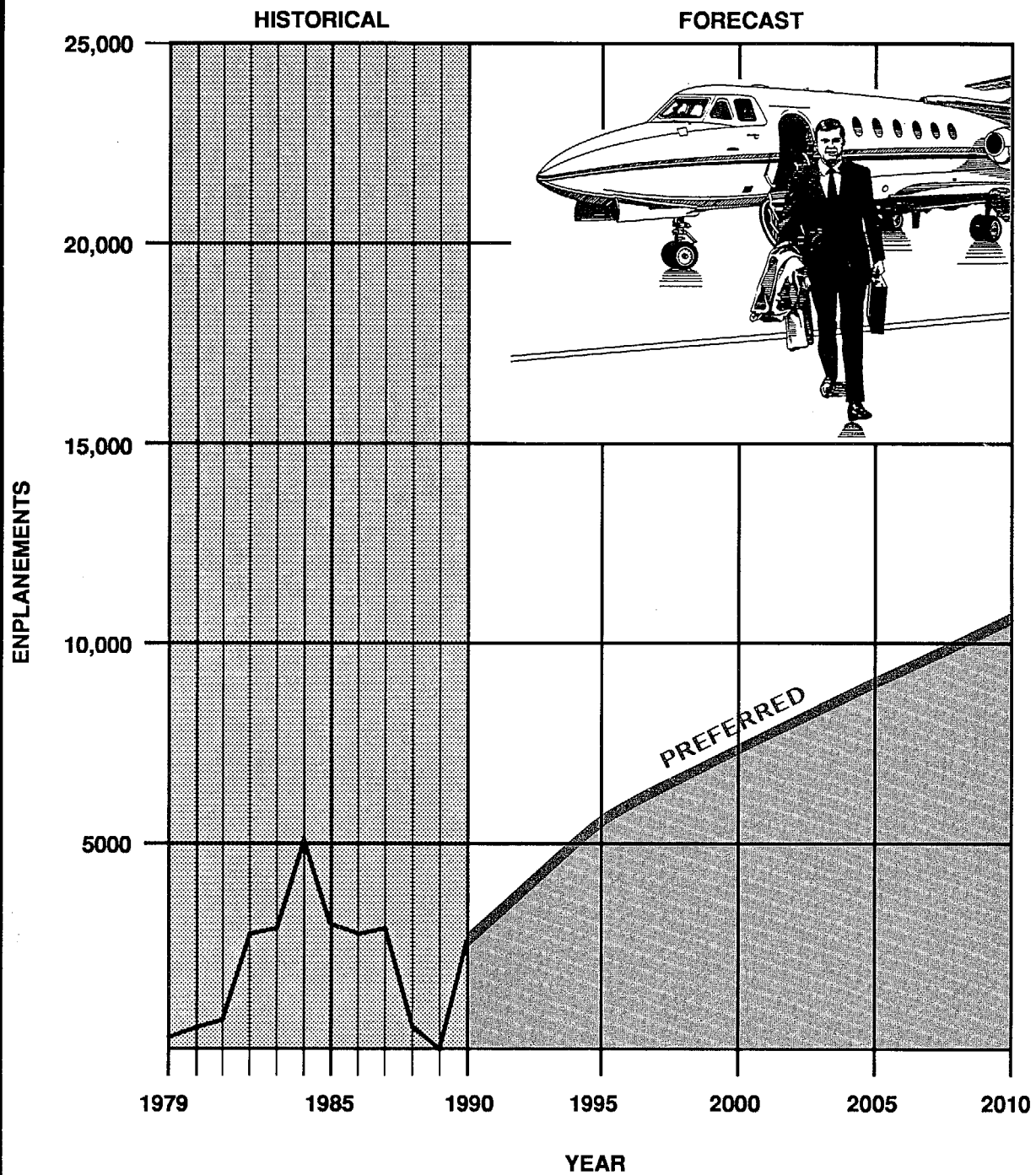
In addition to passenger enplanements, there are other factors which affect forecasts of airline facilities. The number of airline operations can be determined from the average ratio of passenger enplanements per departure. This ratio is dependent upon the size of the aircraft and the average percentage of seats that are filled for each departure. This percentage of enplanements to available seats is called the *boarding load factor* (BLF).

The boarding load factor is important to airline companies because it serves as a measure of airline profit from a given market. When the BLF is high, an airline will often consider increasing the number of seats or the number of flights available. This factor affects each airline to varying degrees,

depending upon the deliver of aircraft equipment available and the market strategy of the airline.

Although Mesa Airlines has only been operating for a short period of time at the Kingman Airport, their boarding load factor for this period has been consistent with those reported in the Kingman Terminal Area Master Plan for the market they serve. As the enplanement levels rise, a change to larger equipment or more frequent flights may occur. This factor needs to be considered in the forecast of commercial operations at Kingman Airport.

Historically, several different types of aircraft have been used for passenger service at kingman Airport. The more recent historical expereience reveals a trend toward aircraft in the seven to 19 capacit range. Currently, Mesa Airlines is serving the Kingman area



NOTE: 1990 figure based on estimate

with 13 to 15 passenger aircraft. It is anticipated that the majority of the aircraft serving the airport will be in this passenger capacity range throughout the planning period. As enplanements rise, however, 19-passenger commuter aircraft might be used at certain times to meet peak demand periods.

In developing a forecast of airline operations, consideration was given to the type of aircraft, based on several ranges of seating capacity that would be expected to operate at the airport (0 to nine, ten to 15, and 16 to 19 passenger aircraft). Table 2B summarizes the commercial operation forecasts according to aircraft seating capabilities, passenger demand, and boarding load factors. To compute annual operations, the average seats per aircraft was first multiplied by the BLF to obtain the average enplanements per departure. Next, annual departures were

obtained by dividing annual enplanements by enplanements per departure. Finally, total airline operations were obtained by multiplying departures by two.

Air taxi forecasts consist of unscheduled operations by commercial courier and small parcel operators, as well as chartered aircraft operations. Due to inadequate historical records for air taxi operations at Kingman Airport, forecasting was based on an estimate of total operations for the year 1990. This estimate for 1990, developed from a review of available Unicom records, was 1,600. It was assumed that air taxi operations would continue to reflect a somewhat constant percentage of total general aviation operations. The air taxi forecast reflects approximately eight to ten percent of the total general aviation operation forecasts.

TABLE 2B
Airline Fleet Mix and Operations
Kingman Airport

<u>Seating Range</u>	<u>Average Seats</u>	<u>1990 ⁽¹⁾</u>	<u>1995</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
0-9	5	0%	0%	0%	0%	0%
10-15	13	95%	90%	85%	83%	80%
16-19	18	5%	10%	15%	17%	20%
Over 20	30	0%	0%	0%	0%	0%
Seats/Departure		13	14	14	14	15
Boarding Load Factor		.22	.30	.35	.37	.40
Enplanements/Depart.		3	4	5	5	6
Annual Enplanements		2,700 ⁽²⁾	5,500	7,300	8,900	10,500
Annual Departures		907	1,400	1,500	1,700	1,900
Annual Commuter Operations		1,814	2,700	3,000	3,500	3,800
Annual Air Taxi Operations		1,600	2,000	2,500	3,100	4,000

Note: ⁽¹⁾ Existing calculations based upon 6 months data, January-June 1990.

⁽²⁾ Projected estimate based on records of actual enplanements for January-June 1990.

GENERAL AVIATION FORECASTS

General aviation activity comprises the majority of aircraft operations at Kingman Airport. General aviation is defined as that portion of civil aviation which encompasses all facets of aviation except commercial airline operations and military aircraft operations. To determine the types and sizes of facilities that should be planned to accommodate general aviation activity, certain elements of this activity must be forecast. These indicators of general aviation demand include the following.

- ♦ Based Aircraft
- ♦ Aircraft Fleet Mix
- ♦ Annual Aircraft Operations

The single most important factor in the development of aviation activity forecasts at a general aviation airport is the number of based aircraft. By first developing a forecast of based aircraft, the other general aviation indicators (operations and fleet mix) can be calculated based upon the factors characteristic to Kingman Airport and the area it serves.

BASED AIRCRAFT FORECAST

In 1980 there were approximately 211,000 general aviation aircraft in the United States, and by 1988, this total had decreased to 210,000. While nationally this number decreased, Kingman Airport based aircraft numbers have continued to grow during these years at a relatively modest rate. Based on historical based aircraft records from FAA Form 5010's, in 1979 the number of aircraft based at the airport was 30, but by 1989, this figure had more than doubled to 68 (not including 10 ultralight aircraft that are based at the airport). In addition, the growth in based aircraft experienced during this period

exceeded that projected in the 1985 Kingman Terminal Area Master Plan (Table 2C).

Historically, there has always been a close correlation between registered and based aircraft at airports, which would indicate Kingman Airport is continuing to attract general aviation aircraft in spite of national and state indications to the contrary.

A *trend line* forecast was prepared and analyzed based on the 1979-1989 historical period. The historical growth rate over this period averaged 15 percent annually. The forecast results produced through this trend line analysis are listed in Table 2C.

Another method used to project future based aircraft levels was *linear regression* analyses. Two independent variables, registered aircraft and population, were used in these calculations. The correlation factor for the linear regression with registered aircraft was poor and was not considered further.

The correlation factors for population linear regressions that were completed were much higher. The two population bases with the highest correlation (R-value) were the State of Arizona (.97) and the City of Kingman (.96). The results of these two regressions are provided in Table 2C.

A *market share* analysis was also performed to forecast based aircraft. This analysis involved the use of ratio of historical based aircraft at Kingman Airport to that of Mohave County, and to the State of Arizona. The market share ratio used was calculated from the most current year for which the data was available, or 1989. Using this ratio and projections of Mohave County and Arizona based aircraft for the twenty year planning period, projections of future based aircraft for Kingman were determined. The projections of future registered aircraft in Arizona and Mohave County were taken from the *Arizona Airports System Plan, 1988*.

The results are included in Table 2C.

Also included in Table 2C are forecasts of based aircraft levels produced by the National Plan of Integrated Airport Systems, 1986-1995 (NPIAS), the Arizona Aviation System Plan (SASP), 1988, Arizona Aviation Needs Study (SANS), 1990, and the Terminal Area Master Plan for the Kingman Airport (1985).

The based aircraft projections included in the Terminal Area Master Plan and the Arizona SASP forecasts appear to be too low since some of these projections are lower than the actual number of aircraft currently based at the airport. With the steady growth exhibited historically, no significant drop in the number of aircraft based at the airport is anticipated.

TABLE 2C
Historical and Forecast Based Aircraft
Kingman Airport

<u>Historical Based Aircraft</u>								
<u>Years</u>	<u>Single Engine Piston</u>	<u>Twin Engine Piston</u>	<u>Multi Engine Piston</u>	<u>Twin Engine Turboprop</u>	<u>Jet Engine</u>	<u>helicopters</u>	<u>Other</u>	<u>Total</u>
1978 ⁽²⁾	27	3	0	0	0	0	0	30
1979 ⁽²⁾	27	3	0	0	0	1	0	31
1980 ⁽²⁾	27	3	0	0	0	1	0	31
1982 ⁽²⁾	35	6	0	0	0	2	0	43
1985 ⁽²⁾	38	8	0	0	0	4	4	54
1988 ⁽²⁾	37	18	3	0	0	2	10	70
1989 ⁽²⁾	51	12	3	0	0	2	10	78
1980 ⁽³⁾	50	14	3	0	0	2	11	80
<u>Forecasts</u>								
<u>Years</u>	<u>Historical Trend Line</u>	<u>Linear Regression Arizona Pop.</u>	<u>Linear Regression Kingman Pop.</u>	<u>Market Share AZ Reg. Acft.</u>	<u>Market Share Mohave Cty. Reg. Acft.</u>			
1995	86	91	98	104	83			
2000	103	113	132	124	93			
2005	121	134	155	142	102			
2010	138	156	185	162	111			
<u>Years</u>	<u>Terminal Area Master Plan (1985)</u>	<u>Arizona SASP (1988)</u>	<u>NPIAS (1985)</u>	<u>SANS 1990</u>	<u>Preferred</u>			
1995	65	51	64	45	91			
2000	73	58	-	47	113			
2005	83	65	-	-	134			
2010	-	74	-	52	156			

Preferred Based Aircraft Forecast

The forecast of based aircraft derived from a linear regression of based aircraft to Arizona population was selected as the preferred forecast for Kingman Airport. This forecast represented a very high correlation and is believed to be the most reasonable based on historical trends. Historical growth in based aircraft at Kingman more than doubled in ten years. It is anticipated that future growth will continue at a somewhat slower rate in the future.

This forecast may be affected by the current reconstruction of Laughlin-Bullhead Airport, in Bullhead City, only 36 air miles to the west. Once the new airport is constructed (dedication of the new airfield is scheduled for November 1991), the marketing strategy of airport management and the competitiveness of the general aviation facilities provided by both airports may influence the based aircraft forecast at Kingman Airport. The forecast projects roughly a doubling of based aircraft in twenty years. The preferred forecast is illustrated on Exhibit 2D.

FLEET MIX

The aircraft fleet mix anticipated at the

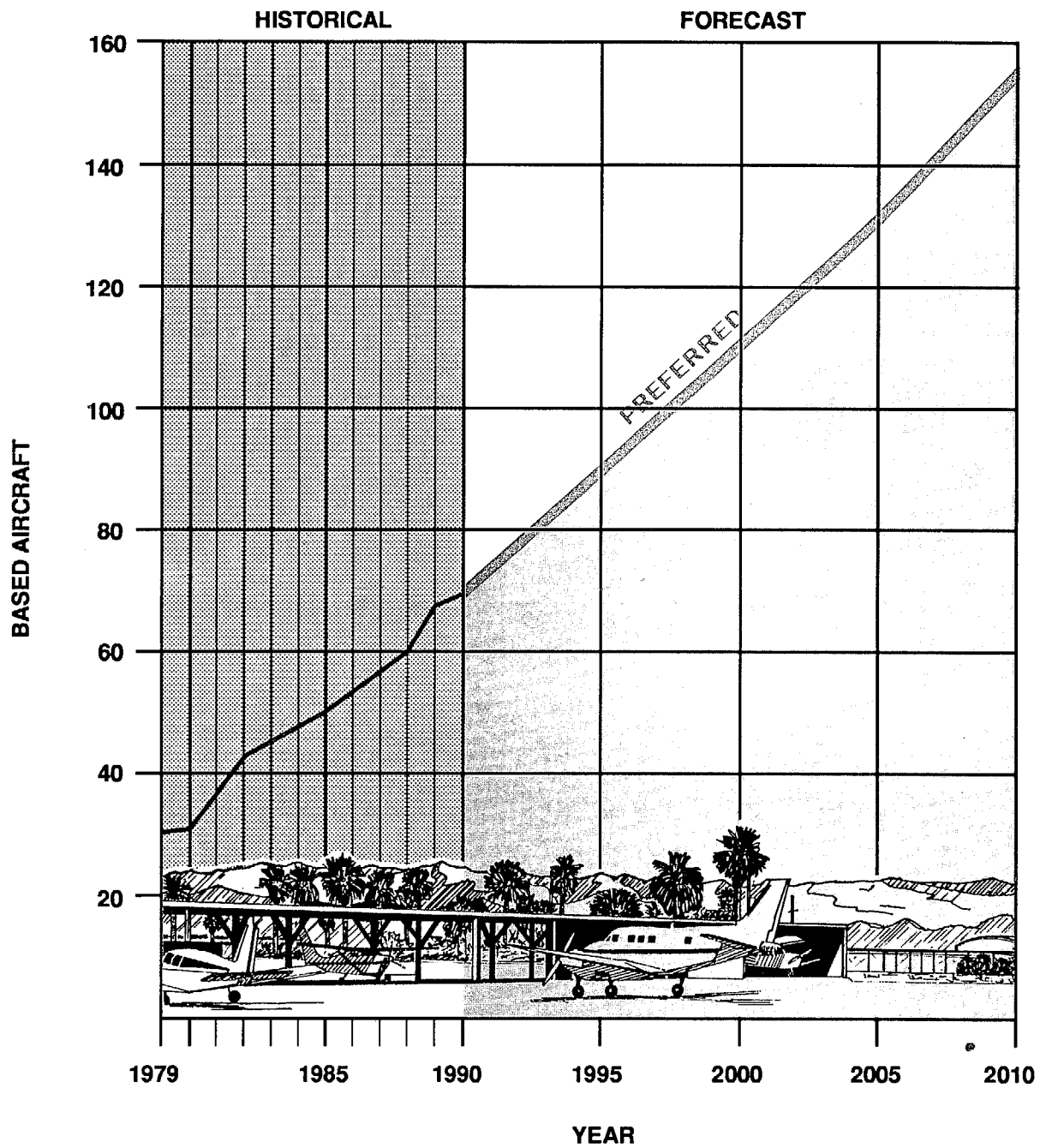
airport must be known in order to properly size future airport facilities. The existing based aircraft fleet mix at Kingman Airport (excluding ultralight aircraft) consists primarily of single engine aircraft (75 Percent). The remainder of the based aircraft is comprised of twin and multi-engine aircraft, turboprop and jet aircraft, helicopters and ultralight aircraft.

The national trend in general aviation is toward a slightly higher percentage of larger, more sophisticated aircraft. A similar trend expected to occur at Kingman Airport. The FAA Aviation Forecasts, FY 1989-2000, projects that active single engine piston aircraft is projected to decline at an annual rate of 0.4 percent, falling from 171,000 in 1988 to 162,000 in the year 2000. According to these national forecasts, the aircraft categories that are increasing in numbers are the turbine powered aircraft, helicopter, and the "Other" aircraft category which includes balloons, ultralights, etc.

To forecast an aircraft mix for based aircraft at the Kingman Airport, the results of the 1990 Arizona State Aviation Needs Study, Aviation Demand and Revenue Forecasts were also reviewed. In consideration of the existing mix of aircraft based at Kingman and the anticipated trends for the State as a whole, the forecast for the 20 year planning period was developed (Table 4D).

TABLE 2D
Based Aircraft Forecast 1995-2010
Kingman Airport

Type	Existing 1989	1995	2000	2005	2010
Single Engine	51	59	74	88	102
Multi Engine Piston	15	16	19	21	23
Twin Engine Turboprop	0	1	2	4	8
Jet	0	0	1	3	4
Helicopter	2	3	5	5	8
Other	10	12	12	13	11
Total	78	91	113	134	156



GENERAL AVIATION OPERATIONS

Historical Trends

An airport *operation* is defined as any takeoff or landing performed by an aircraft. There are two types of operations, *local* and *itinerant*. A local operation is a take off or landing performed by an aircraft that will operate within the local traffic pattern in sight of the airport or will execute simulated approaches or touch-and-go operations (an aircraft that performs a landing and takeoff without coming to a complete halt on the runway). Itinerant operations are all aircraft arrivals and departures other than local. Generally, local operations are comprised of training operations and itinerant operations are those aircraft with a specific destination away from the airport. Typically, itinerant operations increase with business and industry use since business aircraft are used primarily to move people from one location to another.

Without an Air Traffic Control Tower to monitor and record aircraft operations, operational activity at the airport can only be estimated. Historical operations estimates for Kingman Airport were available on FAA Form 5010's for the years 1979 to 1988, and served as the base of historical data for forecasting analyses. These estimates ranged from 18,000 for 1979 to 24,000 for 1988. While these figures are only estimates, they do reflect a continual growth in general aviation operations at Kingman Airport. The average annual growth rate for this period was 3.7 percent. Air Taxi and Commercial operations were omitted from these total operation estimates since forecasts of these types of operations were developed separately.

Supplementing the estimated historical operations information, is data derived from an aircraft activity count that was conducted at the airport for the period of July 16 to Sept 23, 1982. This activity count resulted in an estimate of 19,400 annual operations for

1982. In addition, as a part of this master plan, Unicom logs were reviewed and the data compiled to prepare an estimate of total operations for 1989 and to provide information regarding aircraft fleet mix, peak periods, and runway use. Total operations conducted during the hours that the Unicom was in operation (7:30 a.m. to 5:00 p.m.) for 1989 totalled 17,671. It is estimated that approximately 25 percent of the airport's operations are conducted during periods when the Unicom is not in operation. Adjusting this figure upward to reflect the 25 percent of operations not accounted for in these records, results in a 1989 estimate of approximately 23,588 operations. Because of the fact that all of the historical operations data are estimates, forecasts based solely on these figures might not provide a true picture of future activity.

General Aviation Operations Forecast

Trend line forecasts were analyzed based on the 1979-1988 historical period. The trend line established an average annual growth rate in operations of approximately 4.7 percent for the planning period. The trend line forecast is illustrated in Table 2E.

Another method used to project general aviation operational levels was *linear regression* analysis. Independent variables, including population and personal income, were used in these calculations. Each of these independent variables were considered for three population segments: the City of Kingman, Mohave County, and the State of Arizona. The results reflected a higher correlation for population than for personal income, although relatively close. In addition, the State of Arizona had the highest correlation of the three population segments. All population segments produced high R-values (.94 for the City of Kingman, .95 for Mohave County, .97 for the State). Forecast growth rates using these three linear regressions ranged from an average annual

growth rate in general aviation operations of five to seven percent (Table 2E).

A *market share* analysis with the national operational levels was also performed. Share of each market (general aviation local, and itinerant operations) were averaged during the 1979-1988 period and projections made for the planning period using these average market shares. An overall increase in market share was not anticipated during the planning period (Table 2E).

The general aviation market forecast was obtained from the FAA Aviation Forecasts, 1989-2000. Although the FAA Aviation forecasts did not cover the period from 2001 to 2010, operations projections were made for this period based upon the federal average annual growth rates. By extrapolating projections for the planning period for the years 2005 and 2010, a complete forecast was obtained. The market share forecast is illustrated in Table 2E.

Another, very common forecasting method for projecting general aviation operations is the use of a ratio of operations to based aircraft. Based on 1989 data for Kingman Airport, the ratio of operations to based aircraft equalled 346. Assuming that this ratio will increase over the planning period, this ratio was adjusted upward from 346 in 1990 to 390 for the year 2010. Applying these ratios to projected based aircraft totals for 1995, 2000, 2005 and 2010, resulted in the forecast of operations presented in Table 2E.

Also included in Table 2E are forecasts of operational levels produced through the National Plan of Integrated Airport Systems, 1986-1995 (NPIAS), the FAA Terminal Area Forecast, 1989-2000 and the Arizona Airports System Plan, 1988, (SASP), Arizona Aviation Needs Study (SANS), 1990 as well as the previous Terminal Area Master Plan for the Kingman Airport, 1985.

TABLE 2E
Forecasts of General Aviation Operations
Kingman Airport

	Linear Regression Arizona <u>Population</u>	Linear Regression Mohave County <u>Population</u>	Linear Regression Kingman <u>Population</u>	Average Market ⁽¹⁾ Share U.S.G.A. <u>Operations</u>	Historical Operations Trend Line	SANS 1990
1995	32,100	29,900	34,200	36,000	32,100	25,100
2000	37,500	34,200	42,800	39,800	36,700	26,200
2005	42,600	38,3090	48,600	43,600	41,300	-
2010	48,000	42,900	56,200	47,800	46,000	29,000
	Operations Per Based <u>Aircraft</u>	Arizona SASP <u>(1988)</u>	FAA Aviation Forecasts <u>(1989-2000)</u>	NPIAS <u>(1986-1995)</u>	Terminal Area Master Plan <u>(1985)</u>	<u>Preferred</u>
1995	32,396	22,320	21,000	33,000	36,200	37,800
2000	41,471	25,856	25,000	-	40,600	44,000
2005	50,652	29,953	-	-	45,900	50,200
2010	60,840	34,968				56,800

Notes: (1) Forecast of U.S. General Aviation operations compiled from FAA Aviation Activity Forecasts, 1989-2000.

Preferred General Aviation Operations Forecasts

The forecast derived from a linear regression of operations to Arizona population was selected as the preferred forecast. This forecast, which is illustrated in Table 2F and Exhibit 2E, represents an annual average growth rate of approximately 5.1 percent for the 20 year planning period. This growth rate

is somewhat faster than the 2.9 percent average annual growth rate experienced over the previous ten years at the airport. It is anticipated that a positive population growth rate in conjunction with a moderate growth in the economy will sustain this level of operational activity. The split of itinerant versus local operations presented in this table was estimated based on a review of Unicom records for 1989 and the first half of 1990.

TABLE 2F
Preferred General Aviation Forecasts
Kingman Airport

General Aviation Operations			
<u>Year</u>	<u>Itinerant</u>	<u>Local</u>	<u>Total</u>
1995	28,200	9,600	37,800
2000	32,400	11,600	44,000
2005	37,000	13,200	50,200
2010	41,900	14,900	56,800

MILITARY OPERATIONS

Based on the estimated data provided on the FAA Form 5010's, the military has operated at Kingman Airport since the early 1960's. Military activity has grown during the past ten years reaching a high point in 1988 (approximately 2,000 annual operations), but has subsequently declined. The majority of the military operational activity is associated with the Arizona National Guard and is expected to fluctuate at around 1,000 operations annually for the foreseeable future. Military operations forecast is included in Table 2H.

ANNUAL INSTRUMENT OPERATION FORECAST

Forecasts of annual instrument approaches

(AIA) provide guidance in determining an airport's requirements for navigational aid facilities. An instrument approach is defined by FAA as "...an approach to an airport with intent to land by an aircraft in accordance with an Instrument Flight Rule (IFR) flight plan, when the visibility is less than three miles and/or when the ceiling is at or below the minimum initial approach altitude."

Based on interviews with operators at the airport, it is estimated that actual IFR weather conditions exist at the airport less than three percent of the year. More than 97 percent of the operations, including practice instrument approaches, are normally conducted under VFR weather conditions.

During actual IFR conditions, local general aviation operations generally cease. Therefore, to estimate the number of AIA's

that would occur at the airport during these conditions, only itinerant landing were considered. If we assume that IFR weather conditions exist three percent of the time at Kingman Airport, we can estimate AIA's at three percent of itinerant general aviation,

commercial and military landings. Table 2G summarizes the forecast of AIA's for Kingman Airport. These forecasts are included in Table 2G.

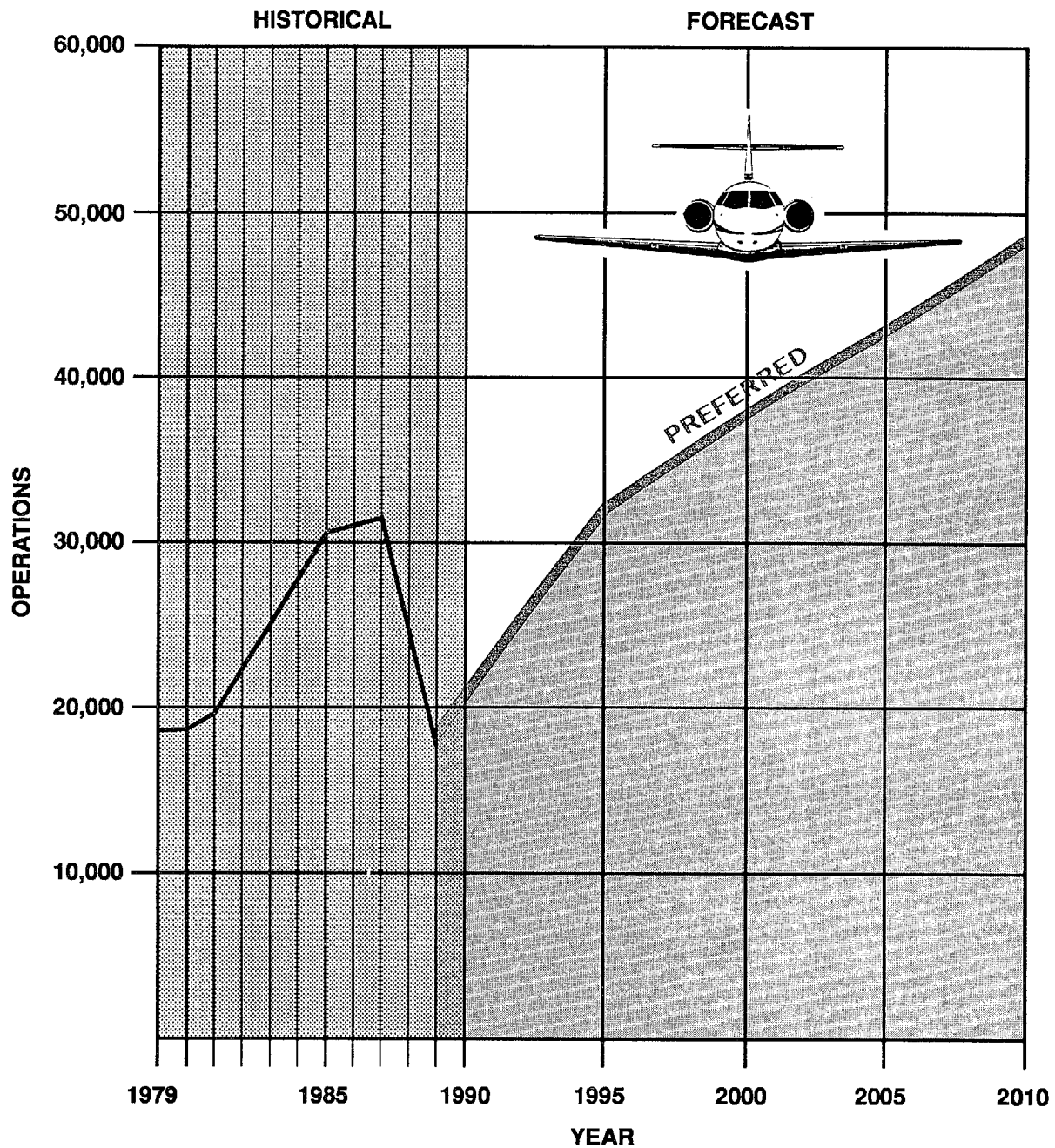
TABLE 2G
Forecast of Annual Instrument Operations
Kingman Airport

	<u>1995</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
Total Operations	37,800	44,000	50,200	56,800
Itinerant Operations	28,200	32,400	37,000	41,900
Annual Instrument Approaches				
Commuter/Air Taxi	70	80	100	120
Military	20	20	20	20
General Aviation	340	390	440	500
Total Instrument Approaches	430	490	560	640

PEAKING CHARACTERISTICS

Many airport facility needs are related to the levels of activity during peak periods. The periods used to develop facility requirements for this study are as described as follows.

- ♦ **Peak Month** - The calendar month when peak aircraft operations occur.
- ♦ **Design Day** - The average day in the peak month. Normally this indicator is easily derived by dividing the peak month operations by the number of days in the month.
- ♦ **Busy Day** - The busy day of a typical week in the peak month. This descriptor is used primarily to determine ramp space requirements.
- ♦ **Design Hour** - The peak hour within the design day. This descriptor is used particularly in airfield demand/capacity analysis, as well as in determining terminal building and access road requirements.
- ♦ **Busy Hour** - The peak hour within the busy day. This descriptor is used particularly in passenger facility requirement determinations.



NOTE: (1) Forecast of U.S. General Aviation Operations
compiled from FAA Aviation Activity Forecasts, (1989-2000)
(2) 1990 figure based on estimate

It is important to note that only the peak month is an absolute peak within a given year. All the others will be exceeded at various times during the year. However, they do represent reasonable planning standards that can be applied without over-building or being too restrictive.

An analysis of enplanement and operations data for Kingman Airport was made to determine the airport's peaking characteristics. By reviewing the peaking characteristics of similar type general aviation and commercial service airports in Arizona and relating them to the characteristics of Kingman Airport, a reasonable forecast can be made.

COMMERCIAL SERVICE PEAKING CHARACTERISTICS

Unfortunately, accurate statistical measurements of peaking activity were not available for this analysis. A review of recent Unicom records was completed and standard methodology was applied to provide a reasonable estimate of the future commercial service peaking conditions at Kingman Airport. The forecast peaking characteristics have been included in the Summary of Forecasts, **Table 2H**.

GENERAL AVIATION PEAKING CHARACTERISTICS

Design Hour Operations

The number of Design Hour operations at this airport are approximately 14 percent of the design day. At most general aviation airports, the design hour can represent as much as 25 percent of the design day operations. However, at the levels of operational activity at Kingman Airport, both existing and forecast, the design hour is expected to remain essentially at this percentage throughout the planning period.

Based on Unicom records reviewed, October was the peak month of the year in 1989. Peak month operations were approximately 11 percent of total operations in 1989. The peak month operations as a percentage of annual operations is expected to remain at about this same level, declining slightly to about 10 percent near the end of the planning period.

The design day activity was anticipated to be approximately 24 percent greater than the average daily operations at the end of the planning period.

Design Hour Passengers

The definition of general aviation passengers as used in this section, refers to the average number of pilots and passengers expected to utilize the airport's terminal facilities during a given time.

This would essentially involve all operations except touch-and-go's, since this type of operation only makes use of the runway to land and immediately takeoff. Pilots conducting touch-and-go operations would not utilize the terminal facilities except at the start and finish of their training activity. In order to ensure that space requirements were not overestimated in the planning effort, these operations were not considered in determining design hour passengers. It is estimated that touch-and-go activity presently contributes approximately 10 percent of the peak hour operations. Touch-and-go activity is expected to rise slightly, to 30 percent of total operations in the future, as more local training occurs along with airport growth. In calculating the design hour passengers, an average of 2.1 passengers per operation (excluding touch-and-go operations) was assumed for existing conditions since much of the current traffic consists of larger general aviation aircraft. This average, incorporated into the design passengers illustrated in **Table 2H**,

is anticipated to remain approximately the same throughout the planning period.

SUMMARY

In this chapter, the forecasts of aviation demand that are essential to effectively

analyze the future needs of the airport have been developed. The next step in this master plan process is to assess the capacity of the existing facilities and determine what facilities will be necessary to meet both the existing and future demand. Table 2H provides a summary of the key aviation forecasts that were analyzed and formulated in this chapter.

TABLE 2H
Summary of Forecasts 1995-2010
Kingman Airport

<u>Descriptor</u>	<u>1995</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
Based Aircraft				
Single Engine Piston	59	74	88	102
Multi Engine Piston	16	19	21	23
Turboprop	1	2	4	8
Turbojet	0	1	3	4
Helicopters	3	5	5	11
Other	12	12	13	11
Total	91	113	134	156
Aircraft Operations				
Itinerant				
Commuter	2,700	3,000	3,500	3,800
Air Taxi	2,000	2,500	3,100	4,000
General Aviation	22,500	25,900	29,400	33,100
Military	1,000	1,000	1,000	1,000
Total	28,200	32,400	37,000	41,900
Local				
General Aviation	9,600	11,600	13,200	14,900
Total	9,600	11,600	13,200	14,900
Total Operations	37,800	44,000	50,200	56,800
Annual Instrument Operations	430	490	560	640
Peaking Factors				
General Aviation Operations				
Peak Month	4,000	4,600	5,300	5,800
Design Day	130	150	170	186
Design Hour	18	20	23	25
Busy Day	162	187	213	233
Busy Hour	40	45	46	34
Airline Activity				
Operations				
Annual	2,700	3,000	3,500	3,800
Peak Month	250	280	320	350
Design Day	8	9	11	12
Design Hour	1	1	2	2
Enplanements				
Annual	5,500	7,300	8,900	10,500
Peak Month	550	730	890	1,000
Design Day	18	24	30	33
Design Hour	3	4	5	5